Springs and the Water Cycle

A spring is a place where water moving underground finds an opening to the land surface and emerges, sometimes as just a trickle, maybe only after a rain, and sometimes in a continuous flow. Spring water can also emerge from heated rock underground, giving rise to hot springs, which people have found to make a delightful way of soaking away their problems.

Water cycle components » Atmosphere · Condensation · Evaporation · Evapotranspiration · Freshwater lakes and rivers · Groundwater flow · Groundwater storage · Ice and snow · Infiltration · Oceans · Precipitation · Snowmelt · **Springs** · Streamflow · Sublimation · Surface runoff

What is a spring?

A spring is a water resource formed when the side of a hill, a valley bottom or other excavation intersects a flowing body of **groundwater** at or below the local water table, below which the subsurface material is saturated with water. A spring is the result of an **aquifer** being filled to the point that the water overflows onto the land surface. They range in size from intermittent seeps, which flow only after much rain, to huge pools flowing hundreds of millions of gallons daily.

Springs are not limited to the Earth's surface, though. Recently, scientists have discovered hot springs at depths of up to 2.5 kilometers in the **oceans**, generally along mid-ocean rifts (spreading ridges). The hot water (over 300 degrees Celsius) coming from these springs is also rich in minerals and sulfur, which results in a unique ecosystem where unusual and exotic sea life seems to thrive.

Rainbow Springs, Florida, USA

A spring is a water resource formed when the side of a hill, a valley bottom or other excavation intersects a **flowing body of groundwater** at or below the local water table, below which the subsurface material is saturated with water. A spring is the result of an aquifer being filled to the point that the water overflows onto the land surface. They range in size from intermittent seeps, which flow only after much rain, to huge pools flowing hundreds of millions of gallons daily.

Credit: Alan Cressler, USGS. Public domain.

How are springs formed?

Springs may be formed in any sort of rock. Small ones are found in many places. In Missouri, the largest springs are formed in limestone and dolomite in the karst topography of the Ozarks. Both dolomite and limestone fracture relatively easily. When weak carbonic acid (formed by rainwater percolating through organic matter in the soil) enters these fractures it dissolves bedrock. When it reaches a horizontal crack or a layer of non-dissolving rock such as sandstone or shale, it begins to cut sideways. As the process continues, the water hollows out more rock, eventually admitting an airspace, at which point the spring stream can be considered a cave. This process often takes tens to hundreds of thousands of years to complete.

Water flow from springs

The amount of water that flows from springs depends on many factors, including the size of the caverns within the rocks, the water pressure in the aquifer, the size of the spring **basin**, and the amount of **rainfall**. Human activities also can influence the volume of water that discharges from a spring-groundwater withdrawals in an area can cause water levels in the aquifer system to drop and ultimately decreasing the flow from the spring. Most people probably think of a spring as being like a pool of water—and normally that is the case. But, as this picture of the wall of the Grand Canyon in Arizona shows, springs can occur when geologic, hydrologic, or human forces cut into the underground layers of soil and rock where water is in movement.

Spring water is not always clear

Water from springs usually is remarkably clear. Water from some springs, however, may be "tea-colored." This picture shows a natural spring in southwestern Colorado. Its **red iron coloring** and metals enrichment are caused by groundwater coming in contact with naturally occurring minerals present as a result of ancient volcanic activity in the area.

In Florida, many surface waters contain natural tannic acids from organic material in subsurface rocks, and the color from these streams can appear in springs. If surface water enters the aquifer near a spring, the water can move quickly through the aquifer and discharge at the spring vent.

This water is cold and clear—is it fit to drink?

Influx of metal-rich groundwater from natural springs (foreground) to Cement Creek, Colorado (background).

Credit: Briant A Kimball

The quality of the water in the local groundwater system will generally determine the quality of spring water. The quality of water discharged by springs can vary greatly because of factors such as the quality of the water that recharges the aquifer and the type of rocks with which the groundwater is in contact. The rate of flow and the length of the flowpath through the aquifer affects the amount of time the water is in contact with the rock, and thus, the amount of minerals that the **water can dissolve**.

So, should you feel confident about whipping out your canteen and filling it with cool and refreshing spring water? No, you should be cautious. The temperature of an Ozark spring comes from its passing through rock at a mean annual temperature of 56 degrees Fahrenheit. The water is crudely filtered in the rock, and the time spent underground allows debris and mud to fall out of suspension. If underground long enough, lack of sunlight causes most algae and water plants to die. However, microbes, viruses, and **bacteria** do not die just from being underground, nor are any agricultural or industrial pollutants removed. By the way, no, this man is not getting a drink from this tempting spring. He is a **USGS hydrologist** sampling the near-boiling water from a spring in Wyoming.

Thermal springs

Hot springs coexist with icebergs in Greenland

Happy Greenlanders and tourists enjoy the unique experience of dipping in the hot springs while enjoying drifting icebergs floating by on Uunartoq Island at the far southern tip of Greenland. These hot springs provide visitors with a perfect bath temperatures of about 100°F.

Credit: Wikipedia

We're betting the number of places you can view icebergs while sitting in hot springs is very small!

Thermal springs are ordinary springs except that the water is warm and, in some places, hot, such as in the bubbling mud springs in Yellowstone National Park, Wyoming. Many thermal springs occur in regions of recent volcanic activity and are fed by water heated by contact with hot rocks far below the surface. Even where there has been no recent volcanic action, rocks become warmer with increasing depth. In such areas water may migrate slowly to considerable depth, warming as it descends through rocks deep in the Earth. If it then reaches a large crevice that offers a path of less resistance, it may rise more quickly than it descended. Water that does not have time to cool before it emerges forms a thermal spring. The famous Warm Springs of Georgia and Hot Springs of Arkansas are of this type. And, yes, warm springs can even coexist with **icebergs**, as these happy Greenlanders can tell you.